INTERNAL COMBUSTION ENGINE PISTON

The present application claims the benefit of United Stated Provisional Patent Application Serial No. 60/392,412 filed June 28, 2002, and entitled INTERNAL COMBUSTION ENGINE PISTON. The provisional patent application is incorporated herein by reference.

BACKGROUND OF THE INVENTION

The present invention relates generally to internal combustion engine pistons. More particularly, in one embodiment the internal combustion engine piston of the present invention includes a combustion bowl therein with fuel flow control structure for redirecting a portion of the fuel within the combustion chamber.

In view of the increasing environmental and legislative pressures worldwide to improve engine exhaust emission, engine manufacturers are focusing more attention on the development of new engines to achieve substantial reductions in emissions without compromising combustion efficiency or specific fuel consumption. One important requirement for clean combustion in an internal combustion engine is the movement of fuel within the combustion chamber.

Although many of the prior internal combustion engine piston designs are steps in the right direction, there still remains a need for additional improvement to satisfy the environmental and legislative pressures. The present inventions satisfy this and other needs in novel and non-obvious ways.

SUMMARY OF THE INVENTION

In one form of the present application there is contemplated an apparatus comprising a piston having a longitudinal centerline and a first end, the piston having a circumferential sidewall portion and a bottom wall portion defining a combustion bowl within the piston at the first end, the sidewall portion including a sharp edge at the first end of the piston and a substantially rounded lip spaced axially from the sharp edge, the combustion bowl defined at the sharp edge is round and the rounded lip is closer to the centerline than the sharp edge is to the centerline.

In another form of the present application there is contemplated an apparatus comprising a piston body having a longitudinal centerline and a first end surface, the piston body having a combustion bowl defined therein with an entrance adjacent the first end surface, the piston body having a sharp edge portion at the entrance for directing a fuel exiting the combustion bowl away from the first end surface and a rounded portion for receiving a fuel thereon within the combustion bowl, the rounded portion is located closer to the longitudinal centerline than the sharp edge portion is located to the centerline and the entrance is round.

In yet another form of the present invention, there is contemplated an apparatus comprising a piston body having a longitudinal centerline and a first end, the piston body having a circumferential sidewall portion and a bottom wall portion defining a combustion bowl within the piston, the combustion bowl having a substantially round entrance at the first end, the sidewall portion including fuel directing means at the entrance for directing a fuel leaving the combustion bowl away from the first end and

fuel receiving means for receiving a fuel within the combustion bowl, the fuel directing means is located a first distance from the centerline and the fuel receiving means is located a second distance from the centerline, and the first distance is greater than the second distance.

One object of the present invention is to provide a unique internal combustion engine piston.

Related objects and advantages of the present invention will be apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an illustrative view of a portion of a vehicle including an internal combustion engine.

Fig. 2 is an illustrative sectional view of a portion of the engine of Fig. 1 showing a piston comprising one form of the present invention.

Fig. 3 is a view of the piston of Fig. 2 removed from the engine.

Fig. 4 is a view illustrating the movement of fuel within the bowl comprising a portion of the piston of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiments illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

With reference to Fig. 1, there is illustrated a portion of a vehicle 20 including an internal combustion engine 40. While the internal combustion engine 40 has broad application in vehicles the present invention also contemplates the utilization of the engine 40 in non-vehicular applications such as, but not limited to: stationary power plants, generator sets, auxiliary power systems, industrial stationary equipment, marine propulsion. In a preferred form of the present invention the internal combustion engine 40 is a compression ignition (diesel) internal combustion engine. However, gasoline, spark ignition and other types of internal combustion engines are contemplated herein. The reciprocating piston internal combustion engine 40 includes an engine block and at least one combustion chamber. Of course, the engine may contain a plurality of combustion chambers, typically four to eight, which may be arranged in line or in a "V" configuration. In a preferred form of the present invention the engine contains a plurality of combustion chambers.

With reference to Fig. 2, there is illustrated a portion of engine 40 including the cylinder block 21, piston 22 and cylinder head 23. In a preferred form the cylinder head 23 is removable and a gasket 30 is disposed between the cylinder head 23 and the engine block 21. Further, the piston 22 has been illustrated within the cylinder cavity 25 with the rings removed. Although not specifically illustrated, the piston 22 is connected through a connecting rod to the crankshaft of the internal combustion engine. The internal combustion engine causes the piston 22 to reciprocate along a rectilinear path within the cylinder cavity 25. A combustion chamber 24 is formed at end of the cylinder cavity 25 and is bounded by the cylinder head 23 and the top surface of the piston 22. A fuel injector nozzle 26 injects fuel into the combustion chamber. In a preferred form of the present invention the fuel injector nozzle 26 delivers a plume of fuel to a portion 27 of the piston 22 the discharge of the fuel. The present invention contemplates variations in the engine, including, but not limited to, other fuel injection systems, combustion chamber shapes, number and location of valves, and cylinder cavities having a removable cylinder liner.

With reference to Fig. 3, there is illustrated the piston 22 removed from the cylinder cavity 25 of the internal combustion engine 40. In one form the piston is an integral metallic structure formed of a heat resistant alloy. However, the present application contemplates that the piston could be of a variety of other styles, including, but not limited to, an articulated piston, monobloc piston, forged piston, multi-piece piston, and other configurations known to those of skill in the art. The piston may be formed of a metallic, intermetallic, ceramic, and/or composite material. The material is

preferably selected to withstand the normal temperatures and pressures associated with an internal combustion engine combustion chamber. The illustrated piston 22 includes a head 52 having a crown 53 and a piston skirt 54 extending from the head 52. However, depending on the type of piston configuration, there may be some differences in the basic structure of the piston. The piston further includes a plurality of piston ring grooves 100, 101 and 102 for receiving piston rings therein (not illustrated). The location and number of ring grooves 100, 101 and 102 are not meant to be limiting, and pistons having other numbers and locations of ring grooves are contemplated herein.

The upper surface 50 of piston 22 is provided with a cavity 51, which will generally be referred to as a combustion bowl. More specifically, the combustion bowl 51 is formed in the piston 22 and extends downwardly from the crown 53 to a bottom wall. The bottom wall has been illustrated as having a substantially Mexican-hat shape. However, other geometric shapes are contemplated herein including, but not limited to round, no-apex, or highly reentrable bowls. In a preferred form the combustion bowl 51 is symmetrical about a centerline X and has a substantially circular shape. A portion 27 of the piston defines a rounded lip extending circumferentially along an intermediate location of the combustion bowl 51. In one form of the portion 27 overlays a portion of the region 103 of the bowl 51. An upwardly flared outer bowl section 60 is formed in the piston adjacent to the rounded lip 27 and extends toward the substantially sharp lip portion 61. The sharp lip portion 61 extends along the circumference of the combustion bowl 51 adjacent the top surface 50. In one form the sharp lip portion 61 includes an upstanding wall 62 that extends from the sharp lip portion 61 towards the upwardly flared

outer bowl section 60. The sharp lip portion 61 includes a sharp edge 75 defined at the junction between the top surface 50 of the piston and the upstanding wall 62. In one embodiment the upstanding wall 62 extends about 1 millimeter from the top surface 50 of the piston. In a more preferred form of the invention the upstanding wall 62 is substantially parallel to the centerline X. In one embodiment a radius 70 transitions from the upstanding wall 62 to the upwardly flared outer bowl section 60. The diameter of the combustion bowl 51 at the sharp lip portion 61 is represented by arrow 'B' and the diameter of the combustion bowl at the rounded lip portion 27 is represented by arrow 'L'. In one form of the present invention the diameter 'B' is about 70 millimeters and the diameter 'L' is about 56.5 millimeters. In one form the piston 22 has a diameter within the range of about 3 inches to about 6 inches, and more preferably has a diameter of about 4 inches. However, pistons having other sizes are contemplated herein unless specifically provided to the contrary. Further, other lengths and sizes are also contemplated herein.

The structure of the piston 22 has been set forth above with the aid of Figs. 2 and 3. With reference to Fig. 4, there is illustrated one application wherein the fuel plume 80 from the injector is targeted at the circumferential rounded lip 27 in the combustion bowl 51. A portion of the fuel plume 80 runs up the upwardly flared outer bowl section 60 and hits the sharp lip portion 61 at the top surface 50 of the piston. This configuration directs the portion of the spray plume from the combustion bowl 51 up into the combustion chamber 24 in the general direction of arrow 'Y'. It has been found that the present invention prevents the spray plume from spilling over onto the top surface 50 of the

piston and running up against the cylinder cavity wall 90. Thereby reducing the discharge of black smoke and/or particulate emissions and minimizing the passage of fuel and/or soot into the engine oil.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiment has been shown and described and that all changes and modifications that come within the spirit of the invention are desired to be protected. It should be understood that while the use of the word preferable, preferably or preferred in the description above indicates that the feature so described may be more desirable, it nonetheless may not be necessary and embodiments lacking the same may be contemplated as within the scope of the invention, that scope being defined only by the claims that follow. In reading the claims it is intended that when words such as "a," "an," "at least one," "at least a portion" are used there is no intention to limit the claim to only one item unless specifically stated to the contrary in the claim. Further, when the language "at least a portion" and/or "a portion" is used the item may include a portion and/or the entire item unless specifically stated to the contrary.